# 2 How to View an Eclipse Safely

It's not the eclipse that is dangerous to observe, it's the Sun! The Sun's visible (and invisible) rays can cause serious damage to the sensitive tissues of the eyes, often without being immediately aware of it! Normally, our common sense protects us from looking directly at the Sun for more than a second. But during an eclipse, astronomical enthusiasm can overwhelm common sense, and people can wind up staring at the Sun for too long. Make sure all attendees have something with them to protect their eyes before the eclipse becomes total – or if they are only seeing the partial eclipse.

## Are eclipses of the Sun dangerous to watch?

The few minutes of total eclipse (when the Sun is completely covered) ARE safe, but anytime that even a small piece of the bright Sun shows, your eyes are in danger. Paper glasses with special filters made of protective material will be sold in lots of places. (Make sure that on the back, in small print, they say that they are ISO 12312-2 certified.) Sunglasses are NOT sufficient to protect your eyes!

To summarize: If you are lucky enough to be in the path of the total eclipse, you can and should remove your glasses during the few minutes that the eclipse is total, so you can take in the beauty of the scene. But if you are viewing the partial eclipse only, you must keep your glasses on anytime you are looking in the direction of the Sun.

Girls and Woman With Eclipse Glasses

## What are some ways I can watch the eclipse safely when part of the Sun is still visible?

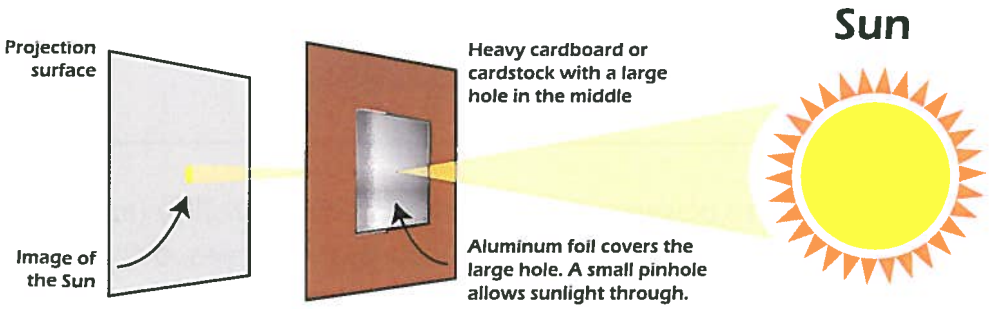
**A. Sun Filters to Look Directly at the Sun**

To look at the Sun directly, except during the total phase of the eclipse, you need a good filter that can cut out not just its intense light, but also its ultraviolet and infrared waves. Sunglasses or smoked glass are NOT OK! If you have access to welder's supplies (and not many people do), #14 arc-welder's glass is an excellent filter (but it has to be #14 and not lower numbers). Or you can use special black or aluminized polymer filters that are sold as eclipse glasses; but make sure you get them from a reliable source and that they are certified. Companies making and selling them in bulk include:

**American Paper Optics:**
http://www.eclipseglasses.com/

**Rainbow Symphony:**
http://www.rainbowsymphony.com/

**Thousand Oaks Optical:**
http://www.thousandoaksoptical.com/




Simple Pinhole Projector
(not shown to scale)
(Credit: NCIL)

### B. Pinhole Projectors to Indirectly View Sun

If you don't have safe glasses, a good way to see the eclipse is to project an image of the partially eclipsed Sun. One easy method is to make a pinhole projector: Take two pieces of cardboard or thick paper. Put a pinhole in one (taking care to make a small, neat hole). Then stand with your back to the Sun, and let the Sun's light fall through the hole and onto the other sheet. You'll get a small but distinct image of the Sun. (To get a sharper pinhole, cut a square out of the middle of one cardboard, tape a sheet of aluminum foil over the hole and put the pinhole in the foil instead of paper.) The further apart the two pieces of paper, the larger the image of the Sun will be (but it will be a small image in any case).

You can also make a pinhole projector inside a box, such as a shoebox, cereal box or a tube (e.g. poster shipping box). You can find links to the following instructions on the *STAR_Net STEM Activity Clearinghouse*, or at:

**Shoebox:**
http://static.nsta.org/extras/solarscience/chapter3/3.10PinholeProjectionInABox.pdf

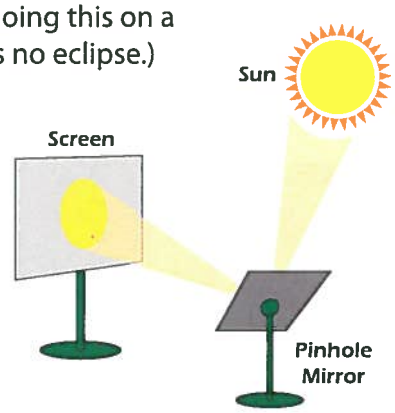
**Cereal box:**
http://hilaroad.com/camp/projects/eclipse_viewer/eclipse_viewer.html

**UPS Triangular Shipping Box:**
https://www.exploratorium.edu/eclipse/how-to-view-eclipse

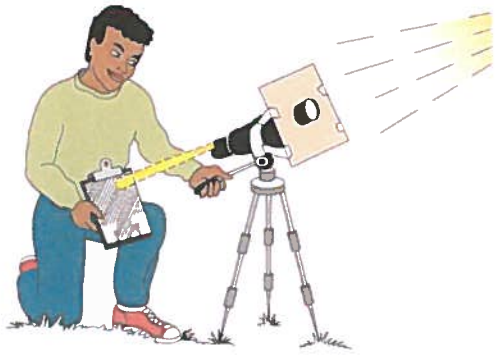
Again, the image of the eclipsed Sun on the box will be quite small, but distinct.

### C. Reflecting the Sun with A Covered Mirror

To project a larger image than a pinhole projector provides, take a hand-mirror or other small mirror, and cover it up. For example, you can use an envelope to make a jacket for it. Cut out a hole the size of a dime (or smaller) in the covering to reveal a small part of the mirror. Now use that small mirror to reflect the light of the Sun onto a light wall or poster paper some distance away. The further away the projected image is from the mirror, the larger it will look. (It's a little tricky to orient the mirror so that the Sun is shining on it and it reflects the image where you want it to go. It's best to practice doing this on a day when there is no eclipse.)




Mirror reflecting Sun
(not shown to scale)
(Credit: NCIL)



Binocular Projection
(Credit: Dennis Schatz, *Astro Adventures*, and *Solar Science*)

### D. Projecting an Image of the Sun through Binoculars

You can use one side of a pair of binoculars to project a larger image of the eclipsed Sun. First put a secure lens cap on (or tape cardboard to) one lens on the larger end of the binoculars to block the light. Then take a piece of cardboard and cut out a hole the size of the lens on the larger side of the binoculars. Tape the cardboard to the binoculars, making a kind of sunshade through which one lens shows.

Attach the binoculars to a tripod or other device to hold the binoculars steady. Point the large end of the binoculars toward the Sun and have someone else hold a white sheet or cardboard some distance away from the smaller end. Move things around until you see an image of the Sun on the paper or cardboard. Use the focus knob of the binoculars to make the Sun's image sharper.

**Important Note:** *You should definitely NOT look at the Sun through binoculars or a telescope, because they concentrate the rays and make looking at the Sun MORE dangerous, not less. However, such instruments may be used to look directly at the Sun IF, and only if, you have a certified solar filter designed to fit them and know how to use it!*

A Note about Telescopes: If you have a tight-fitting, certified solar filter and know how to use it, a telescope can also be used to view the Sun or project an image of it.

### E. Using a Colander

If none of these materials are available, you can hold up a colander toward the partially eclipsed Sun, and look in the opposite direction from the Sun for the light and shadow pattern on the ground or a wall. You will see many tiny images of the eclipsed Sun.

Using a colander to make an image of a partial eclipse on a white wall. (Credit: Ally Bing)

**The information in the preceding pages has been adapted from two sources:**

1) *Solar Science* by Dennis Schatz and Andrew Fraknoi, published in 2016 and © by the National Science Teachers Association. All rights reserved. The book features a wide array of hands-on activities and information about the Sun, its movement in the sky, its effects on Earth (such as the seasons), and its eclipses. For information, see: http://www.nsta.org/solarscience


2) "Run a 2017 Eclipse Event for Friends, Neighbors, and Profit" by Douglas Duncan, first published in Summer 2015 issue of *Mercury*, the magazine of the Astronomical Society of the Pacific. You can read the entire article here:

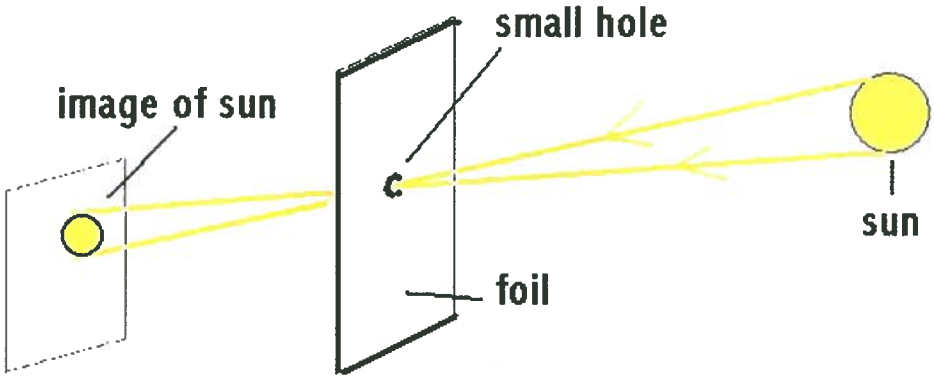
https://cdn.shopify.com/s/files/1/0744/4007/files/2017_event.pdf

# Cereal Box Eclipse Viewer

Looking directly at the sun is extremely dangerous, damage to the retina occurs in a few seconds and is not reversible. During a solar eclipse (moon blocking the sun) it is very tempting to look directly at this event, doing so usually results in eye damage.

The event can be safely viewed by looking at a projected image of the sun.

A small hole in a piece of foil acts much like a lense, creating an image. A device that uses a small hole to create an image is called a **pin-hole viewer.**



# Building a Pin-Hole Viewer


A cereal box makes an excellent pin-hole viewer. (Any box will do).


If the bottom of the box isn't white, glue a white piece of paper to the bottom. This makes it easier to see the projected image.


Cut the ends off the box tabs as shown. This creates two openings, one for the foil the other for viewing.

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Tape aluminum foil over one of the openings.

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With a small (~ 3mm diameter) nail, push a hole through the foil.
The size of the hole isn't critical, you can experiment with different sizes.

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Hold the finished pin-hole viewer with the sun shining on the pin-hole.
The sun will be behind you. **Never look directly at the sun!**

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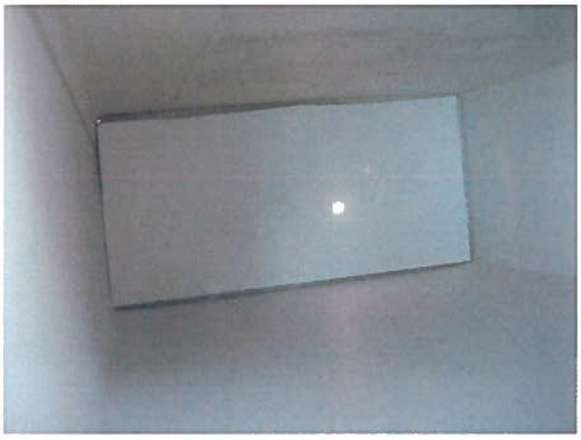

While looking in the opening, move the box until an image of the sun appears on the bottom.
You are now safely viewing an image of the sun. This is a safe way to view an eclipse.

An eclipse would look like this through your pin-hole viewer.
https://eclipse2017.nasa.gov/eclipse-kit